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PATENT SPECIFICATION

Application Date: Oct. 2, 1920. No. 28,007/20. 172,784

Complete Left: July 1, 1921.

Complete Accepted: Dec. 22, 1921.

PROVISIONAL SPECIFICATION.

Improvements in or relating to the Manufacture of Pneumatic Tyres.

We, THE DUNLOP RUBBER COMPANY, LIMITED, a British company, of Dunlop House, 1, Albany Street, Regent's Park, in the County of London, and COLIN MACBETH, Experimental Engineer, of the aforesaid company's works at Fort Dunlop, Erdington, Birmingham, in the County of Warwick, a subject of the King of Great Britain, do hereby declare the nature of this invention to be as follows:—

This invention relates to the manufacture of pneumatic tyre covers or casings and has particular reference to the manufacture of large section tyres which have to withstand heavy loads. Pneumatic tyres with wired on or other beads as generally constructed have a bead core placed on each side of the casing, and each bead core usually has an equal number of cover plies placed below and above it but in some instances more plies are placed above or below the bead to suit the circumstances and the ideas of tyre designers. In practice it is found that on large sizes of tyres such as used on heavy motor vehicles there is a tendency for the plies to separate from the bead cores due to the great pull or strain upon the latter. Many means and suggestions have been proposed and adopted with a view to avoiding this separation tendency, for example, by placing tendons or loops of woven strip around the bead cores in order to increase the adhesion surface and to enable the plies next to each bead core to have a better anchorage thereto; although these tendons or loops improve adhesion they do not reduce the flexing required at the apex of the bead core, which tends to cause separation after the tyre has been in use for a considerable time and this separation tendency is increased when the tyres are run under-inflated. Common means adopted to prevent failure due to lack of adhesion of plies to the bead core has been to interlock the plies as they come below the bead core; thus a ply inside the bead is often brought out below the bead core to the outer corner or brought up the outer surface of the core so as to be covered or locked by an outer ply. A further inner ply (or plies) is turned below the bead and so on thus making the ends of the ply alternate below the beads so as to obtain an interlocking effect. These means are often adopted in conjunction with a number of tendons or loops of canvas in addition to the interlocked casing plies but all these systems are laborious, intricate and slow to carry out.

According to this invention the tendency for the plies to separate from the bead core is avoided by constructing the tyres with multiple bead cores, thereby increasing the number of adhesion surfaces with which the plies are associated in such manner as to reduce the separation tendency at each gripping surface. Further, the construction is such that the apex angle of each bead core is very acute thus providing a fairly flexible "junction" at the point where the plies on either side of the bead core are joined together. The building up of the casing is simplified by overcoming the necessity of interlocking the plies outside and inside the beads and by building up

[Price 1/-]

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successive units of simple construction at the bead portion, for example, by superimposing one unit on another and securely binding or uniting successive units together preferably by an outside ply or plies. A tyre casing built up according to the present invention may have any number of bead core units depending upon the load and conditions under which the tyre is to be run and the bead cores may be of suitable diameters in order to allow for laying or placing of the plies underneath or within the same. The innermost bead cores that is to say, the bead cores at the inner sides of the casing may be of wide section than the outer bead cores. In most instances each bead core has associated with it two groups or sets of casing plies, one group or set lying inside and the other outside the bead core. These groups may consist of any desired number of plies and if desired each bead core may have associated with it a filler strip or strips placed around the core itself and around the outside the group of casing plies associated with it in any known or suitable manner. The outer groups of plies may be hooked round or placed under the outer bead cores and in some examples may be continued so as to hook under the inner bead core or cores whilst the inner group of plies may terminate near the toe of the respective bead cores or may be continued to hook under such inner or adjacent bead cores that may be employed. In some cases a plurality of bead cores may be assembled to form one core with which the plies are associated.

A typical method of building up a casing with multiple bead cores may be carried out as follows:—

The inner group or set of plies may be laid on a core or former by hand or by machine and rolled or spun down by any suitable or known means. The bead core (which may have been previously built up and assembled with a filler strip or strips) is now placed in position against the inner set of plies by any suitable means whereupon the plies of the outer group are applied and rolled down in any suitable manner thus completing the building up of the first bead core unit of the casing. The second bead core unit is then built up in a similar manner, the bead core being first placed in position by suitable means whereupon the plies of the outer group are laid adjacent to the core when the whole of the plies may be cut at the toe of the multiple bead. The built up casing may lie removed from the core or former after one or more chafing or covering strips have been attached to the outer bead surface and after removal from the former, these strips may be turned up to lie on the inside of the bead toes, if required. From the foregoing description it will be understood that the tyre casing may be considered to consist of a number of separate units equal to the number of bead cores and that without sacrificing in any way strength or adhesion, the construction or building up is such that the manufacturing operations are simple and can be performed successively with accuracy and quickness. The simplification of the building up of the tyre is brought about by avoiding the necessity of interlocking the plies above and below the bead core. In one example of a casing having two cores at each bead portion the cores may be of the same diameter and the inner and outer sets or groups of plies may be similarly disposed relatively to each core, that is to say, the inner plies for each core may extend inwardly beyond the core whilst the outer plies are hooked underneath the cores so as to abut against the inwardly projecting portions of the inner plies. In another example in which two cores are provided in each bead portion the inner cores may be of larger diameter than the outer cores. The inner plies for the larger diameter cores extend inwardly beyond these cores whilst the outer plies are hooked underneath the cores so as to abut against the inwardly projecting portions of the inner plies. The inner plies for the outer cores do not extend inwardly beyond these cores but the outer plies are hooked underneath these cores and are made long enough to extend to the innermost ply of the inner set pertaining to the larger diameter core. In a somewhat similar example the inner and outer plies for the larger diameter cores may be arranged so that the outer plies hook or extend under these cores and lie adjacent to the inner plies, but the inner plies for the outer core may extend under the plies pertaining to the larger diameter core; the outer plies for the outer core which pass under these cores may also be extended to lie adjacent to the extended portions of the inner plies, the extremities of these two extended plies being cut so as to be flush with the inner surface of the innermost ply of the inner set pertaining to the larger diameter core. Tyre casings having these cores in each bead portion may be constructed in similar ways to those described above in connection with the

double cores. In one example in which three bead cores of different diameters are used the innermost set of plies is extended radially inwards so that adjacent sets of plies extended under the head cores may also be extended radially inwards whilst the outermost set of plies is hooked under the bead cores so as to abut against the inwardly extended portion of the inner plies pertaining to the outermost bead core. A somewhat similar construction may be used for casings having bead portions with two bead cores. In some tyres, particularly cord tyres, it is desirable to provide a stiffening material between the plies at points above and adjacent to the apex of the bead and this may be effected for example by enclosing the bead cores in canvas pockets and/or stiffeners may be placed between adjacent sets of plies.

Locking means may be provided by extending the two outermost plies round the bead toe and up inside the casing adjacent to the bead portion thereof. This arrangement enables a greater number of plies being laid on the inside of the inner bead cores and a reduced number of plies extending below the cores consequently reducing the distance between the bead cores and the inner circumferential surfaces of the bead portions. Further, a double lock is afforded for the inside plies. The two outer plies in this modification may be laid on before removal of the core but may be turned or placed inside the bead portions at a later stage in manufacturing.

Dated this 2nd day of October, 1920.

HASELTINE, LAKE & Co.,
28, Southampton Buildings, London, England, and
55, Liberty Street, New York, N.Y., U.S.A.,
Agents for the Applicants.

COMPLETE SPECIFICATION.

Improvements in or relating to the Manufacture of Pneumatic Tyres.

We, THE DUNLOP RUBBER COMPANY, LIMITED, a British company, of Dunlop House, 1, Albany Street, Regent's Park, in the County of London, and COLIN MACBETH, Experimental Engineer, of the aforesaid company's works at Fort Dunlop, Erdington, Birmingham, in the County of Warwick, a subject of the King of Great Britain, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to the manufacture of pneumatic tyre covers or casings and has particular reference to the manufacture of large section tyres which have to withstand heavy loads. Pneumatic tyres with wired on or other beads as generally constructed have a bead core placed on each side of the casing, and each bead core usually has an equal number of cover plies placed below and above it, but in some instances more plies are placed above or below the bead to suit the circumstances and the ideas of tyre designers. In practice it is found that on large sizes of tyres such as used on heavy motor vehicles there is a tendency for the plies to separate from the bead cores due to the great pull or strain upon the latter. Many means and suggestions have been proposed and adopted with a view to avoiding this separation tendency, for example, by placing tendons or loops of woven strip around the bead cores in order to increase the adhesion surface and to enable the plies next to each bead core to have a better anchorage thereto; although these tendons or loops improve adhesion they do not reduce the unavoidable flexing at the apex of the bead core, which tends to cause separation after the tyre has been in use for a considerable time and this separation tendency is increased when the tyres are run underinflated. Common means adopted to prevent failure due to lack of adhesion of plies to the bead core has been to interlock the plies as they come below the bead core; thus a ply inside the bead is often brought out below the bead core to the outer corner or brought up to the outer surface of the core so as to be covered or locked by an outer ply. A further inner ply (or plies) is turned below the bead and so on thus making the ends of the ply alternate below the beads so as to obtain an interlocking effect. These means are often

adopted in conjunction with a number of tendons or loops of canvas in addition to the interlocked casing plies but all these systems are laborious, intricate and slow to carry out.

It has also been proposed to provide tyre covers or casings with two or more anchoring members or bead cores at each bead portion of the casing around which anchoring members or bead cores the casing plies are looped and folded back on themselves, whilst an additional ply (or plies) is placed around each bead portion so as to embrace the said bead cores and the looped plies.

According to this invention each bead portion of the tyre cover or casing comprises two or more bead cores and the casing plies are arranged to pass along the inner and outer surfaces of each bead core to the inner circumferential parts of the latter where the plies meet or abut to completely enclose the bead cores, without being looped around the bead cores or interlocked as hereinbefore described. Further, the construction is such that the apex angle of each bead core is very acute thus providing a fairly flexible "junction" at the point where the plies on either side of the bead core are joined together. The building up of the casing is simplified by avoiding the necessity of interlocking the plies outside and inside the beads and by building up successive units of simple construction at the bead portion, for example, by superimposing one unit on another and securely binding or uniting successive units together preferably by an outside ply or plies. A tyre casing built up according to the present invention may have any number of bead core units depending upon the load and conditions under which the tyre is to be run and the bead cores may be of suitable diameters in order to allow for laying or placing of the plies underneath or within the same. The innermost bead cores, that is to say, the bead cores at the inner sides of the casing may be of wider section than the outer bead cores. In most instances each bead core has associated with it two groups or sets of casing plies, one group or set lying inside and the other outside the bead core. These groups may consist of any desired number of plies and if desired each bead core may have associated with it a filler strip or strips placed around the core itself and around the outside of the group of casing plies associated with it in any known or suitable manner. The outer groups of plies may be hooked round or placed under the outer bead cores and in some examples may be continued so as to hook under the inner bead core or cores whilst the inner group of plies may terminate near the toe of the respective bead cores or may be continued to hook under such inner or adjacent bead cores that may be employed. In some cases a plurality of bead cores may be assembled to form one core with which the plies are associated.

In order that the invention may be clearly understood and readily carried into effect, the same will now be described more fully with reference to the accompanying diagrammatic drawings in which:—

Figure 1 is a transverse sectional view of one construction of a tyre cover or casing according to the present invention.

Figure 2 is an enlarged sectional view of one of the bead portions of the cover or casing shown in Figure 1.

Figures 3 and 4 illustrate further modifications of a bead portion having two bead cores.

Figures 5, 6 7 and 8 are sectional views illustrating examples in which the bead portions comprise three bead cores.

Figures 9 and 10 illustrate further modifications hereinafter referred to.

Throughout the various figures the bead portions of a "straight side" tyre are illustrated.

As shown in Figure 1, the bead portions of the cover or casing each comprise two bead cores A, B of which the core A is disposed between an inner set or group of plies A^1 and an outer set or group of plies A^2, whilst the core B is disposed between an inner set or group of plies B^1 and an outer set or group of plies B^2. Each bead core as shown is made with a very acute apex angle so as to provide a flexible junction at the point where the inner and outer plies are in contact. It wil be observed that all the bead cores in the various examples shown are made in this manner and the apex angle is indicated by the reference letters A^x B^x or C^x. In the example shown in Figures 1 and 2 the two cores A and B at each bead portion of the casing are of the same diameter and the inner and outer sets of groups of plies may be similarly disposed relatively to each core, that is to say, the inner plies A^1 or B^1 may extend inwardly beyond the respective cores whilst the outer plies A^2 or B^2 are hooked underneath the respective cores so as to abut against the inwardly projecting portions of the inner

plies A^1 or B^1. In the example shown in Figure 3 the inner bead core A is of larger diameter and wider section than the outer core B. The inner plies A^1 for the larger diameter core A extend inwardly beyond this core whilst the outer plies A^2 are hooked underneath the core so as to abut against the inwardly projecting portions of the said inner plies A^1. The inner plies B^1 for the outer core B do not extend inwardly beyond this core but the outer plies B^2 are hooked underneath the core B and are made long enough to extend to the innermost ply of the inner set A^1 pertaining to the larger diameter core A, thus affording an efficient grip round the core B and uniting both the cores. A somewhat similar example is shown in Figure 4 wherein the inner and outer plies A^1 A^2 for the larger diameter core A are arranged so that the outer plies A^2 hook and extend under the core A and lie adjacent to inwardly projecting portions of the inner plies A^1, but the inner plies B^1 for the outer core B extend under the plies A^1 A^2 pertaining to the larger diameter core; the outer plies B^2 for the outer core B are extended to lie adjacent to the extended portions of the inner plies B^1, the extremities of these extended plies B^1 B^2 being cut so as to be flush with the inner surface of the innermost ply of the inner set A^1 pertaining to the larger diameter core A.

Tyre casings having three cores in each bead portion may be constructed similarly to those described above having the double cores. For example, Figure 5 shows a construction in which three bead cores A B C have associated therewith inner and outer sets of plies A^1 A^2 B^1 B^2 C^1 C^2 which are arranged as described in connection with the example shown in Figure 2. Figure 6 shows a three cored bead portion with the inner and outer sets of plies A^1 A^2 B^1 B^2 C^1 C^2 arranged as described in connection with example shown in Figure 3. In the modification shown in Figure 7 the plies A^1 A^2 pertaining to the core A and the plies B^1 B^2 pertaining to the core B are arranged similarly to the corresponding plies in the example shown in Figure 3 but the inner plies C^1 pertaining to the outermost core C are not extended under the plies pertaining to the other cores A and B. The example shown in Figure 8 illustrates a somewhat different construction of three cores A, B, C and associated plies. The core A is made of increased width by assembling two cores to form a core unit, the two cores being united to produce the acute apex angle A^x as shown. The plies are arranged in such manner that those B^1 between the cores A B serves as the inner plies for the core A and the outer plies for the core B. Similarly the plies C^1 between the cores B and C serve as the outer plies for the core B and as the inner plies for the core C. The inner plies A^1 are extended radially inwards and the plies B^1 and C^1 are extended under the bead cores A, and B and are also extending radially inwards whilst the outermost set of plies C^2 is hooked under the bead core B and C so as to abut against the inwardly extended portion of the inner plies C^1. A somewhat similar construction to that shown in Figure 8 may be used for casings having bead portions with two bead cores, examples of such constructions being shown in Figure 9 and in Figure 10. In some tyres, particularly cord tyres, it is desirable to provide a stiffening material between the plies at points above and adjacent to the apex of the bead and this may be effected for example by enclosing the bead cores in canvas pockets D see Figure 4; stiffening material E may also be placed between adjacent sets of plies as indicated by the broken lines in Figures 4, 9 and 10.

Locking or binding means may be provided by extending the two outermost plies B^{2x} such as shown in Figure 10 under or within the bead portion and up inside the casing so as to lie adjacent to the innermost plies A^1. This arrangement permits of a greater number of plies being laid on the inside of the inner bead cores and a reduced number of plies extending below the cores consequently reducing the distance between the bead cores and the inner circumferential surfaces of the bead portions. Further, a double lock is afforded for the inner plies A^1. The two outer plies B^{2x} in this modification may be laid on before removal of the tyre core or former on which the casing is built up but may be turned or placed inside the bead portions at a later stage in the manufacture of the casing.

Chafing or covering strips F may be applied around the bead portions as shown by dotted lines in Figures 9 and 10.

A typical method of building up a casing with bead portions as described above may be carried out as follows:—

The inner group or set of plies A^1 are laid on the tyre core or former by hand or by machine and rolled or spun down

by any suitable or known means. The bead core A (which may have been previously built up and assembled with a filler strip or strips) is now placed in position against the inner set of plies A^1 by any suitable means whereupon the plies A^2 of the outer group (or the plies B^1 see Figure 8) are applied and rolled down in any suitable manner thus completing the building up of the first unit of the casing. The second unit is then built up in a similar manner, the bead core B being placed in position by suitable means against its previously laid plies B^1 whereupon the plies B^2 (or the plies C^1 see Figure 8) of the outer group are applied and laid round the core; the alternate laying of the plies and the bead cores is continued in this manner according to the number of cores required, and after applying the plies they are cut as and where required generally at or adjacent to the bead toe. The built up casing may be removed from the tyre core or former after one or more chafing or covering strips F such as indicated in Figures 9 and 10 have been attached to the outer surface of the bead portion and after removal of the casing from the tyre core or former these strips F may be turned up to lie on the inside of the bead toes, if required. From the foregoing description it will be understood that the tyre casing may be considered to consist of a number of separate units equal to the number of bead cores and that without sacrificing in any way strength or adhesion, the construction or building up is such that the manufacturing operations are simple and can be performed successively with accuracy and quickness. The simplification of the building up of the tyre is mainly brought about by avoiding the necessity of interlocking the plies above and below the bead cores.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A pneumatic tyre cover or casing of which each bead portion comprises two or more bead cores, with which latter the plies extending around the casing are so arranged as to pass along the inner and outer surfaces of each of the bead cores to the inner circumferential parts thereof where the said plies meet or abut to completely enclose the separate bead cores substantially as and for the purpose specified.

2. A pneumatic tyre cover or casing of which the bead portions each comprise two or more bead cores, each bead core being enclosed between an inner set of plies and an outer set of plies in such manner that the inner parts of the two sets of plies meet or abut at the inner circumferential parts of the bead cores, substantially as and for the purpose specified.

3. A pneumatic tyre cover or casing as set forth in either of the preceding claims in which the bead cores are made with acute apex angles at the points where the casing plies pass on each side of each bead core, substantially as and for the purpose specified.

4. A pneumatic tyre cover or casing as set forth in any of the preceding claims in which the inner or innermost bead cores are wider than the bead cores on the outer side thereof, substantially as described.

5. A pneumatic tyre cover or casing as set forth in any of the preceding claims in which any one or more of the bead core units is or are constituted by two cores united together, substantially as described.

6. A pneumatic tyre cover or casing as set forth in any of the preceding claims in which the several bead cores and plies associated therewith are bound or locked together by the outmost plies which extend under and along the inner sides of the bead portions of the cover or casing, substantially as and for the purpose specified.

7. A pneumatic tyre cover or casing as set forth in any of the preceding claims in which stiffening material is provided adjacent to or between the bead cores, substantially as described for the purpose specified.

8. A method of making pneumatic tyre covers or casings wherein a set of plies is laid around the casing and has a bead core applied thereto at each side, this alternate laying of the casing plies and the application of the bead cores being continued according to the number of bead cores required to form the multiple cored bead portions of the casing, substantially as described.

9. A method of building up pneumatic tyre covers or casings consisting in alternately laying sets of plies around a former and applying bead cores to each set of plies, the inner parts of the several sets of plies being arranged to meet or abut at the inner circumferential parts of the bead cores and finally binding or uniting the assembled bead cores and

plies, substantially as described for the purpose specified.

10. A pneumatic tyre cover or casing in which the casing plies are associated with several bead cores, substantially as described with reference to the accompanying drawings.

11. A pneumatic tyre cover or casing having bead portions constructed and arranged substantially as described with reference to any of the examples illustrated in the accompanying drawings for the purpose specified.

Dated this 1st day of July, 1921.

HASELTINE, LAKE & Co.,
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Agents for the Applicants.

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Fig. 1.

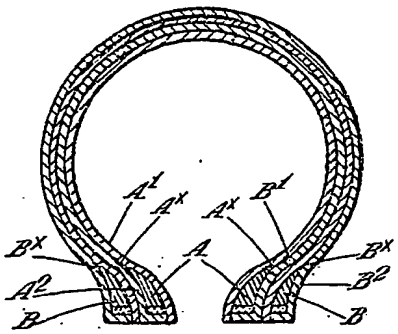


Fig. 2.

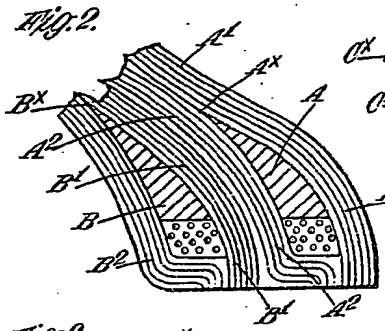


Fig. 5.

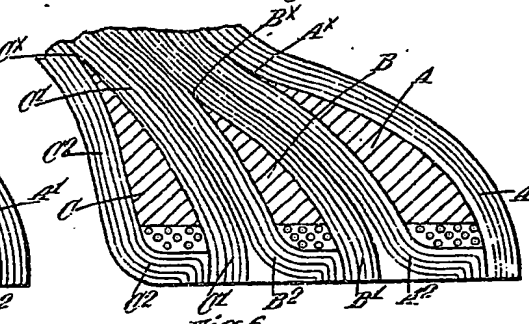


Fig. 9.

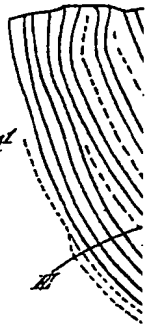


Fig. 3.

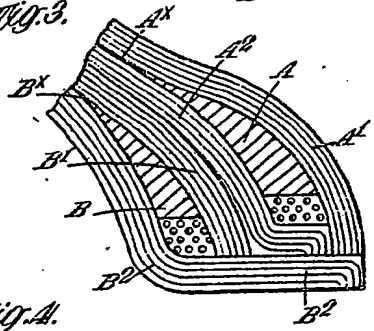


Fig. 6.

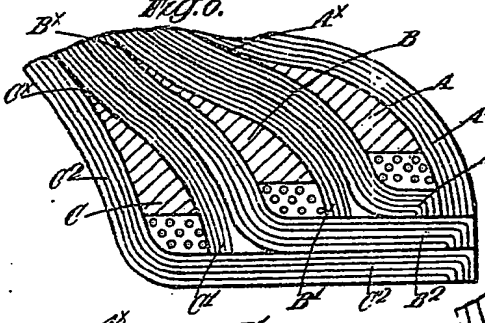
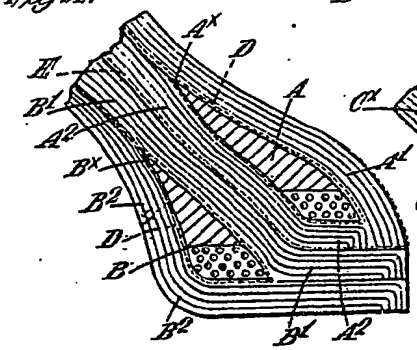


Fig. 4.



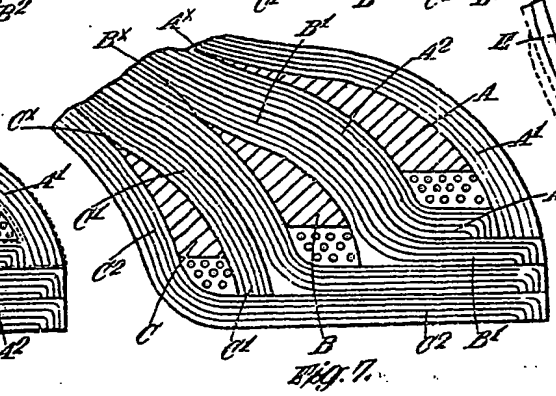
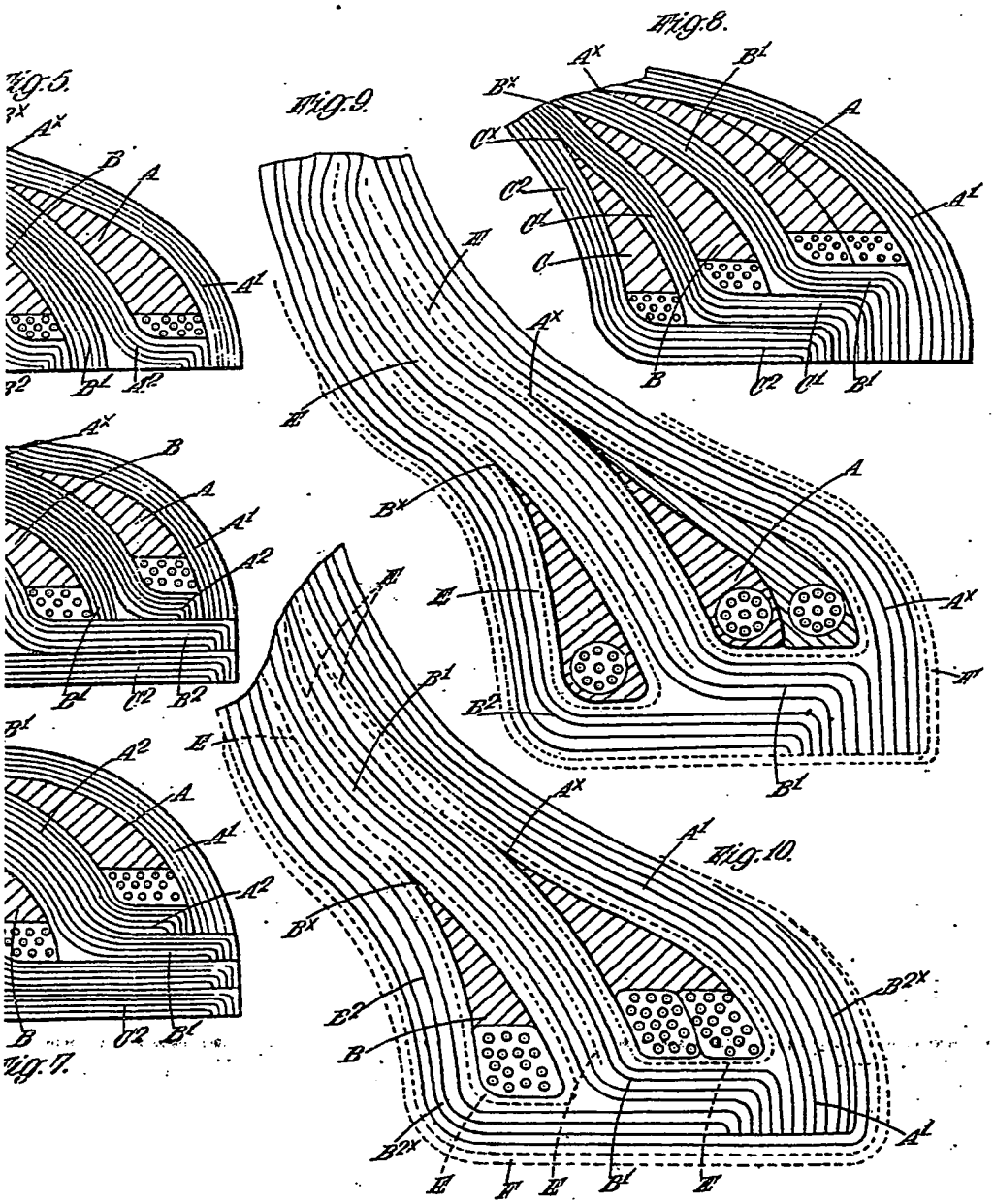


Fig. 7.



Malby&Sons, Photo-Litho

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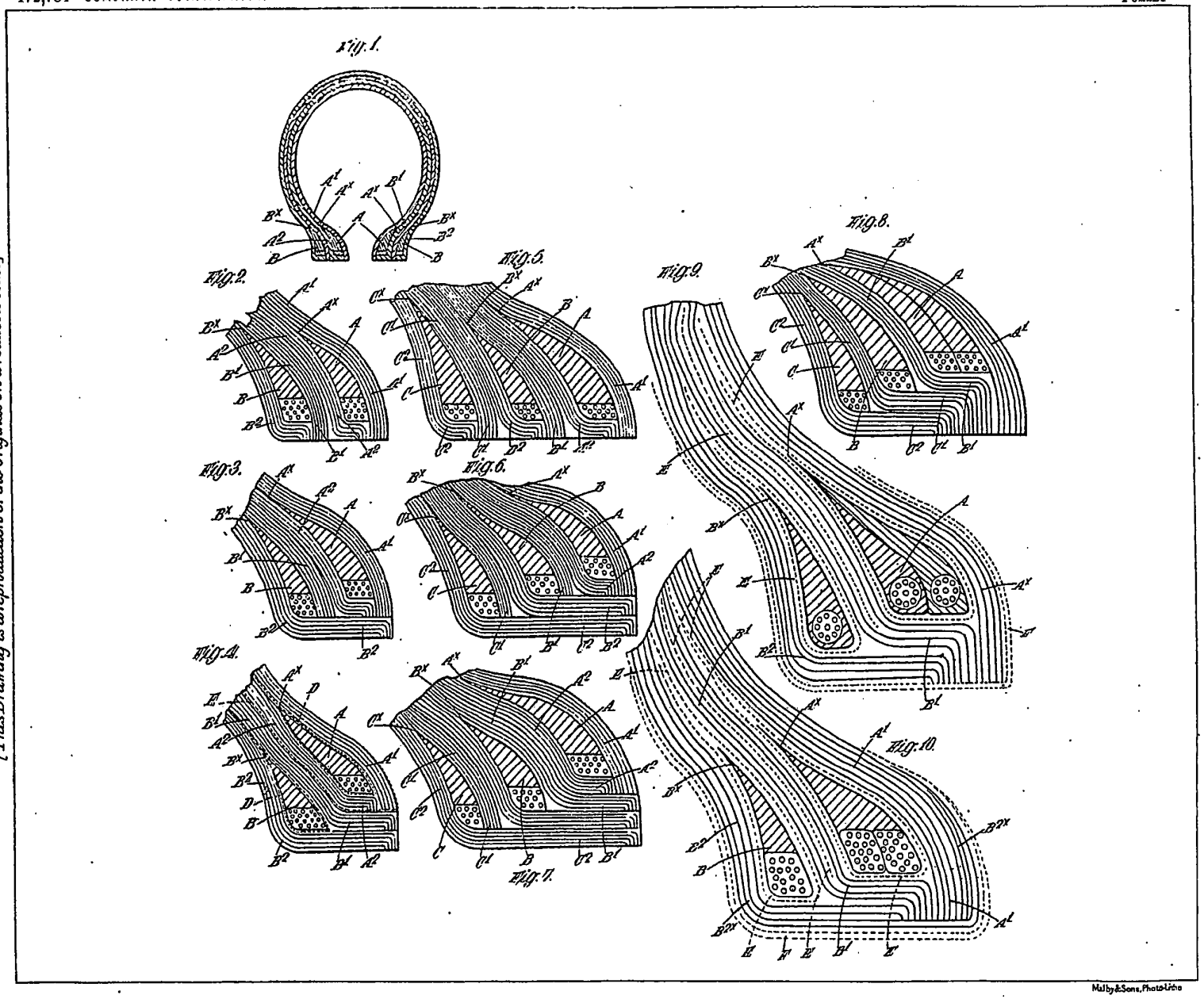

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